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CONSUMER CHOICE AND INFORMATION: NEW EXPERIMENTAL EVIDENCE ON INFORMATION OVERLOAD HYPOTHESIS

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ABSTRACT

This paper reports on a series of experiments designed to explore the so-called "information overload" hypothesis. We generally find that our subjects do quite well at screening out irrelevant information. Further, we find that a key element determining the quality of choices made by our subjects is the number of "salient" attributes, not just the number of attributes for which information is provided. Weak evidence is found which suggests a form of overload might occur when the number of salient dimensions is high and information is given on all of them. Finally, we discuss the implications of these results on the disclosure controversy.

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I. INTRODUCTION

The world of the modern consumer is filled with decisions. A dazzling array of products and services confronts the consumer at every turn. In addition, the consumer has available, sometimes without any apparent choice in the matter, a seemingly unlimited amount of information regarding these products and services. While some might argue that more information is always better from the consumers' point of view, the suggestion that more information might be detrimental to consumers has begun to be taken quite seriously. For example, one argument in favor of simplification presented during the recent congressional debates over revising the Truth-in-Lending Act was based entirely on it. As a Governor of the Federal Reserve System put it:

> The total present disclosure requirements are simply too extensive to permit effective use by the vast majority of consumers. This view is based in part upon . . . advice that the mass of information now provided may produce a kind of "information overload" that overpowers many consumers and renders the entire disclosure statement a forbidding and incomprehensible document. Indeed, behavioral research suggests that when confronted with more than a few "bits" of information, consumers cease to read or retain _any_ of the material offered. (Jackson, 1977, p. 4).

That the behavioral research literature indeed supports these conclusions is not obvious. In fact, very little work related to the

particular form of "information overload" referred to by Mr. Jackson has been done. The original notion of information overload was related to information acquisition, not final choices. Bettman, for example, reports that "several researchers have argued that as task difficulty (measured as the total amount of information, or information load) increases, there will first be increases in search, but then eventually decreases as too high an information load is imposed" (1979, p. 126). He sites Schroder, Driver and Streufert (1967), Streufert, Suedfeld, and Driver (1965) and Sieber and Lanzetta (1964) in support of this view.[1] "Information overload" in these papers refers to the fact that information acquisition eventually decreases as the total amount of information available passes some critical level. Of course this does not directly imply the quality of decisions gets worse--that depends on the nature of the information and the nature of the choice task.[2]

Studies which directly test the information overload hypothesis in a consumer choice environment have been conducted by Jacoby and his associates (Jacoby, Speller and Kohn, 1974; Jacoby, Speller and Berning, 1974). These authors report that "based upon considerable evidence [an alternate view to the 'more is better' position] maintains that there are finite limits to the ability of human beings to assimilate and process information during any given unit of time, and that once these limits are surpassed, behavior tends to become confused and dysfunctional." Studies cited to support this conclusion include Broadbent (1971), Driver and Streufert (1969), Miller (1956) and a number of others (see the references in Jacoby, Speller and Berning, 1974). "Information overload" in this latter work refers to the emergence of confused and dysfunctional behavior as the total amount of information available passes some critical level. While the terms "confused" and "dysfunctional" are somewhat imprecise, this definition appears to be stronger than Bettman's definition because it implicitly links the reduction in information acquisition to the quality of decisions. In fact, the evidence that this strong version of information overload exists is quite limited, and the conclusions drawn from these studies have been severely criticized (Russo, 1974; Wilkie, 1974; Summers, 1974; see also Jacoby, 1977; Jacoby, Speller, and Berning, 1975 for replies).

Jacoby and his associates conducted a number of experiments all based on a common design. First, each subject was interviewed to identify his or her "ideal" brand of some specified product. Further, subjective weights associated with the importance of each attribute of the product were elicited. These were used to provide a base against which accuracy could be measured. Next, each subject was given a number of brands from which to choose (4, 8, 12, or 16), each brand being described by a number of attributes (2, 4, or 6). The objective given each subject was to evaluate the information provided and choose the "best" brand in the set. The "best" brand was defined as the brand least distant from the "ideal" brand, where distance was measured linearly using the attribute weights elicited at the outset of the experiment. Using the product of the number of brands and the number of attributes (i.e., total "bits") as the measure of the information

load, Jacoby and his associates concluded that "providing substantial amounts of package information can result in poorer purchase decisions" (Jacoby, Speller, and Kohn, 1974, p. 40), and that increasing the information load tends to produce "dysfunctional consequences in terms of the consumer's ability to pick the brand which was best for him" (Jacoby, Speller, and Berning, 1974, p. 6).

While the basic experimental design can itself be criticized, Staelin and Payne (1976) reanalyzed the results of these experiments, taking that design as given, and reached substantially different conclusions. By controlling for the effects of pure-chance in selecting the best brand as the number of brands increases (Russo, 1974; Wilkie, 1974) and allowing for the possibility that there may not be an equal trade-off between brands and attributes (Russo, 1974) they find that "decision accuracy is a discontinuous monotonically increasing function with respect to the number of attributes per brand" (1976, p. 189). Thus they conclude that "more information is associated with more accuracy at least within small ranges" (1976, p. 189).

Malhotra (1982) employed a methodology similar to Jacoby's. Subjects rank order up to 25 houses (5, 10, 15, 20, or 25) each of which was described by 5, 10, 15, 20, 25 attributes. Subjects choices were considered correct if the house chosen was the closest to their "ideal house" (termed optimizing) or if the choice was one of the two closest (termed satisficing). The results showed some decreased in accuracy with increasing information load. Malhotra corrected for chance and reported that this made little difference. As with the earlier studies the analysis employed strong assumptions on the utility function of the subjects. Malhotra, Jain, and Lagakos (1982) reanalyzed the data from the studies of Jacoby, et al (1974a, 1974b) and Scammon (1977) and concluded that the evidence in those studies did not support the conclusion "that providing more information results in poorer purchase decisions." They report evidence that subjects in these experiments were capable of processing a large (though finite) amount of information but questioned their motivation.

It is fair, therefore, to say that the current state of the debate concerning the existence of information overload of the strong type--that which effects the quality of final choices--is unresolved. The purpose of this paper is to report on some new experimental evidence addressed to this issue. The results we present suggest that individuals are indeed quite good at making certain types of rather complicated decisions. While some tasks are more complicated than others, the degree of difficulty or "cognitive load" is not well described by simply counting the number of bits of information available. In fact, subjects in our experiments act as if they are quite capable of ignoring irrelevant information. Nevertheless, we do find that a form of information overload may occur when the number of "salient" attributes is high and information is provided on all of them. In fact, one of our most important findings is the crucial role played by the distinction between the number of total attributes and the number of salient attributes.

The next section of this paper will briefly discuss our experimental methodology since it is substantially different from that found in the existing literature. Section III will summarize the results and Section IV will provide a further discussion of these results and their possible implications.

II. METHODOLOGY

Section III will present some new experimental evidence dealing with the extent (or existence) of the strong version of the information overload phenomenon. One goal in these experiments was to avoid some of the flaws in the methodology used by Jacoby and his associates. As noted in the introduction, their experiments have been thoroughly criticized in the consumer research literature so we will not repeat those arguments in this paper.

All subjects were students at colleges and universities in Southern California: viz University of Southern California (USC); Pasadena City College (PCC); California State University at Northridge (CSUN); California State University at Fullerton (CSUF); Occidental College (Oxy); and University of California at Los Angeles (UCLA). Most subjects were recruited from economics and business classes although there were some history, sociology and anthropology students. In some cases subjects heard of the experiments by word-of-mouth and simply volunteered at the specified time and place. During recruitment subjects were told that there was to be an experiment in decisionmaking, that we were economists from Caltech, that they would be paid in cash (at least five dollars), and that the experiment would take about an hour.

Two aspects of our methodology require special comments: the use of sets of lotteries on prospects as items of choice and the use of dominance as a measure of performance. In most consumer research experiments of this type, actual or hypothetical products are used. Often the product is selected on the basis of its inherent interest to the subjects (e.g., if the subject pool is business students, typewriters might be used as the product). This can lead to confounding effects. For example, Scammon (1977), in an experiment related to information overload, exposed subjects to commercials for two brands of peanut butter, Skippy Peanut Butter and Koogle Peanut Butter Surprise, both of which included information on the nutritional content of the products. The data was manipulated so that Koogle dominated Skippy on every dimension. Yet most subjects (88 percent) chose Skippy as "more nutritious" than Koogle on a subsequent questionnaire. Clearly, the choice of products had a dramatic impact on this result.

For many purposes the use of real or fictitious brands is not only convenient but appropriate. In our experiments, since we wished to study choice behavior under varying amounts of information and complexity, we felt it important to control directly the amount of information available. Thus we wish to avoid "importing" information by using brand names or product types, etc. Hammerton (1970) gives an example where responses to a statistical decision problem are amazingly

insensitive to including or deleting logically necessary parts of the problem. The problem, which involved the probability of a diagnosis being correct, received very different responses, however, when it dealt with a medical diagnosis as opposed to a pronouncement of an auto mechanic. The situation is rather similar to that in Grether and Wilde (1984b) in which we studied conjunctive choice rules. The experiments reported there involve decisions concerning rather complicated lotteries structured so that subjects were required to adopt some kind of conjunctive choice rule. The use of lotteries allowed us to manipulate the structure of the problem and to ensure that the dimensions or attributes of the "goods" were indeed independent.

One has to decide which alternative "should" be chosen from any set of choice items--how can we evaluate performance? As mentioned in the introduction, in the experiments of Jacoby and his associates, this was resolved using a parametric representation of a multiattribute utility function and the determination of an "ideal" brand for each consumer. We choose to use an approach which requires weaker assumptions on the utility functions of participants. For all problems we use dominance as the criterion. Thus if there is a single dominant item in a choice set we shall treat choices of that element as correct, and choices of other elements (or indifference) as incorrect. In some cases there are several undominated elements and for these we treat the choice of any one of them as correct.

The advertising literature seems to presume that consumers can easily recognize dominant products (Wright and Barbour, 1975) and, in fact, our experiments confirm this using a design in which choice items are lotteries instead of hypothetical products. Most studies of consumer choice quite rightly avoid choices where there are dominated items. Since consumers do not choose them not much can be learned from including them except as a control to check confusion or lack of attention. A notable exception is Huber, Payne, and Puto (1982) where dominated items were added to sets. That study concerned the dominance relation and its affect on choice (see also Huber and Puto, 1983) thus the presence of dominated items was necessary.

The use of dominance is the rule rather than the exception in experimental economics as is the use of abstract commodities rather than known brands or goods. For a discussion of the methodology and its relevance for consumer reasearch, see Grether and Wilde (1984a). As the information overload hypothesis is about failure of decisionmaking we felt it desirable to have a simple criterion for when a failure had occurred.

We presented our subjects with two primary types of decision problems. In the first, items were simple lotteries with the number of outcomes serving as the number of attributes and the number of lotteries serving as the size of the choice set. Thus in Figure 1, Panel A represents three goods with three-attributes, Panel B represents four goods with five-attributes, and Panel C represents five goods with three-attributes. Whether or not the subjects view the items in Panel B as having five attributes or edit them as suggested by Kahneman and Tversky (1979) is not at issue. Each lottery shown in

Panel B requires more numbers i.e. pieces of information than does one in Panel A. In the second type of decision problem, items were compound lotteries--combinations of simple binary lotteries--with the number of simple binary lotteries serving as the number of attributes and the number of compound lotteries serving as the size of the choice set. Thus, Figure A1 (in the appendix) represents two goods and three-attributes, Figure A2 represents three goods and three-attributes, etc.

Subjects were run together in groups of twenty to fifty depending upon how many volunteered for the experiments. Instructions were passed out and read aloud to the subjects. Subjects were allowed to ask questions, but other than that were to remain silent. The instructions described only one type of lottery problem. When subjects appeared to understand the problem, booklets of problems were passed out and subjects proceeded to make their choices at their own pace. When all subjects were finished the booklets were collected and if another type of decision problem was included in the session new instructions were passed out and the procedure repeated. Sometimes a decision problem would be presented to subjects twice during a session. In this case the problem would be presented in two separate booklets each containing several different problems of the same type. Within a given type of problem the larger, more complex problems were mixed in with the smaller, presumably easier ones. Thus in presentation the problems did not begin with the easier ones and procede to the harder ones (or vice versa). This was done to guard against possible confounding effects of either experience or fatigue, but refers to order of presentation only. Subjects could approach the problems in any order they chose and could change decisions to problems previously solved (within a given booklet). Booklets varied in size from seven to around fifteen problems. At the beginning of each session one subject was selected to act as a monitor. The monitor's job was to generate the random numbers needed during the experiment by using a bingo cage. Subjects were informed at the beginning that one decision problem would be chosen at random by the monitor (using the bingo cage). The set of lotteries constituting that problem would then be "run off" by the monitor (again using the bingo cage) and subjects would be paid, in cash, on the basis of their choices for that problem. The bingo cage contained balls numbered 0,1,...,9. Numbers 1 to 100 were generated by two draws with replacement (treating double zero as 100). Thus all probabilities used in lotteries were expressed operationally in terms of draws from the cage. For example, in Figure 1, Panel A, Item A is a lottery over five, twenty and ten dollar outcomes, with respective probabilities .28, .36, and .36. This was described simply by saying that if a number between one and twenty-eight was drawn the payoff would be five dollars, if a number between twenty-nine and sixty-four were drawn it would be twenty dollars, and the numbers sixty-five through one hundred would yield ten dollars. Thus we were able to avoid references to probabilities or similar terms which might have meant different things to different subjects.

This process is tedious but important. First, the elements of the choice set are homogeneous in the sense that they do not induce

unique, subjective attitudes or valuations other than those related to their potential for generating a high cash reward. This eliminates confounding effects such as those described above in the Scammon study. Second, the use of the bingo cage reduced subjects' speculation as to what was "really going on" or that they might be being "tricked" in some fashion. Thus they could concentrate on the task at hand. Finally, regarding the use of cash incentive payments, Tversky and Kahneman (1977, 1981) have argued that these are <u>not</u> necessary and have cited several examples both from their own work and from others (Grether and Plott, 1979). We are aware of these arguments but have found, at least for some individual decisions involving uncertainty, that these payments seem to produce qualitatively different behavior (Grether, 1981).

III. RESULTS

In this section we discuss the results of several experiments which were run under the methodology outlined in section II.[4] Using compound lotteries we construct sets of lotteries with a fixed amount of information measured as "bits," but which produce dramatically different responses; i.e., the proportion of "correct" choices vary significantly over choice problems with identical formats and amounts of information. For our subjects, at least, problems which caused incorrect responses were those which <u>required</u> the use of a large amount of information, not just those in which a large amount of information was <u>presented</u>. That is, our subjects act as if they are capable of ignoring unnecessary or irrelevant information.

We consider first the set of decisions involving choices over simple lotteries. The order of the problems differed systematically across subjects but will be discussed here according to type. In the simplest, each choice set contained a single dominant element. The lotteries were displayed in a tabular form to facilitate comparisons, but in some cases subjects needed to perform minor calculations (addition) in order to evaluate them. The results are shown in Table 1 and the lotteries themselves are given, in their tabular form, in Figure 1. A large majority (approximately 5:1) chose the undominated item. Within the admittedly narrow range studied this result seems to be independent of the number of attributes to choose from or the number of values the lottery could pay--the number of its "attributes." There is some drop off in performance between the first two sets, but overall the effect is not statistically significant ($\chi^2(2) = 5.0$) at the .05 level.

When the choice set included more than one undominated lottery, subjects generally avoided choosing from among the dominated lotteries, if any were present, but when presented with the same choice situation a second time a substantial fraction switched around among the undominated lotteries. This observation is consistent with observed stochastic choice behavior over sets for which there are no natural orders (Becker, DeGroot, and Marchak, 1963; McAlister, 1982). With these problems it is possible to study whether the structure of the dominance relations effects choice, as suggested by Huber, Payne

TABLE 1: Choices from Sets with Unique Maximal Elements

	From a Set of Three Lotteries		From a Set of Four Lotteries	
Group	Dominant Item	One of the Dominated Items or Indifferent	Dominant Item	One of the Dominated Items or Indifferent
UCLA	55	13	49	19
Oxy	46	5	45	6
PCC	34	9	27	16
USC	40	6	41	6
CSUN	38	2	34	6
CSUF	42	3	40	5
Total	255[a]	38[a]	236[b]	58[b]

Repeated Choices
From a set of Five Lotteries

	First Time		Second Time	
Group	Dominant Item	One of the Dominated Items or Indifferent	Dominant Item	One of the Dominated Items or Indifferent
UCLA	56	12	53	15
Oxy	41	10	46	5
PCC	31	12	36	6
USC	40	7	43	4
Total (matching populations)	168[c]	41[c]	178[d]	30[d]
CSUN	34	6		
CSUF	40	5		
Total	242[e]	52[e]		

a. t (null hypothesis p = 1/3) = 19.4
b. t (null hypothesis p = 1/4) = 21.9
c. t (null hypothesis p = 1/5) = 20.2
d. t (null hypothesis p = 1/5) = 21.8
e. t (null hypothesis p = 1/5) = 24.7

FIGURE I: Set of Lotteries Used in Constructing Table 1

PANEL A

Choose one of the following items:

	$5	$20	$10
Item A	1–28 (28)	29–64 (36)	65–100 (36)
Item B	1–30 (30)	31–60 (30)	61–100 (40)
Item C	1–20 (20)	21–60 (40)	61–100 (40)

PANEL B

Choose one of the following items:

	$5	$20	$5	$10	$5
Item A	1–7 (7)	8–43 (36)	44–50 (7)	51–86 (36)	87–100 (14)
Item B	1–8 (8)	9–38 (30)	39–45 (7)	46–85 (40)	86–100 (15)
Item C	1–4 (4)	5–40 (36)	41–46 (6)	47–91 (45)	92–100 (9)
Item D	1–6 (6)	7–40 (34)	41–47 (7)	48–90 (43)	91–100 (10)

PANEL C

Choose one of the following items:

	$5	$10	$20
Item A	1–28 (28)	29–64 (36)	65–100 (36)
Item B	1–30 (30)	31–70 (40)	71–100 (30)
Item C	1–15 (15)	16–60 (45)	61–100 (40)
Item D	1–23 (23)	24–66 (43)	67–100 (34)
Item E	1–34 (34)	35–68 (34)	69–100 (32)

and Puto (1982) and in Huber and Puto (1983). As these results are more closely related to this latter work than to information overload we shall discuss them in detail elsewhere. We conclude that in general subjects do indeed avoid choosing dominated lotteries.

We next present the results of choices from sets of compound lotteries. For these problems each compound lottery was presented as a set of simple binary (i.e., two outcome) lotteries. These problems seem a priori to be harder than choices among simple lotteries. For example, dominance is more difficult to detect. The problems were presented in tabular form (see Appendix Figures A1-A10) and for payout the value of each simple lottery was determined by drawing from the bingo cage. The total number of "bits" or pieces of information available was varied experimentally by varying the number of items to choose from and the number of attributes (i.e., component lotteries) of each. Each set consisted of one dominant lottery and several dominated ones. In constructing the lotteries we generally made all but one of the component lotteries define identical probability distribution over outcomes. For example, in Figure A6 prospects 1 and 3 of item A, prospects 1 and 2 of Item B and prospects 1 and 3 of Item C each define the same lottery ($1.50 with probability .18, $1.25 with probability .27, $1.10 with probability .22, and $0.85 with probability .33). The sets from which the subjects had to choose contained two to five items and each item was made up of two to five binary lotteries. In some cases all the binary lotteries entailed payments that were roughly the same size and in others only one binary lottery per item involved not trivial sums of money. By varying the number of component lotteries with significant payoffs we hoped to manipulate the number of salient dimensions and in some sense the difficulty of the problem. Note that this treatment can be done holding the size of the problem in terms of the amount of information presented constant. The basic idea can be seen from the following example.

Choose A or B or indicate indifference.

A	\$7 p = .3	and	\$.25 p = .4
	\$5 p = .7		\$.10 p = .6
B	\$9 p = .4	and	\$.20 p = .45
	\$6 p = .6		\$.00 p = .55

It seems evident that B is rather more desirable than A (in fact it dominates it)[6] and 81 percent of our subjects stated a preference for B (237 to 57 with 3 indifferent). Consider on the other hand the following problem:

Choose A or B or indicate indifference.

A	\$7.00 p = .4	and	\$5.00 p = .75
	\$2.00 p = .6		\$3.00 p = .25
B	\$6.50 p = .45	and	\$5.50 p = .75
	\$1.50 p = .55		\$3.50 p = .25

Again B dominates A, although intuitively (at least to us) this is not as easy to see as in the previous problem. For the latter problem the choice requires considering all four simple lotteries whereas it seems

apparent that two of the lotteries in the first problem are essentially inconsequential. Indeed, the subjects in our experiments seem to have found it more difficult as only 170 chose B while 121 chose A (with 14 indifferent).

The results are presented in Tables 2 through 6. In the tables the number of binary lotteries per item with significant payoffs is referred to as the number of dimensions of the problem. Of course we are not concerned with the question of precisely how the subjects made their decisions or whether or not they viewed the decision problem as being of one, two, three, or more dimensions. In fact from Figures A1 to A10 one can see that there were other aspects of the presentation of the choice problems, e.g., the arrangement of the binary lotteries in the display, that varied across problems.

Thus it is apparent that for problems of a given size as measured by the pieces of information presented, one can vary the degree of difficulty (as measured by the proportion of correct responses) in a systematic way. Table 7 summarizes the (observed) degree of difficulty for problems with a common number of "dimensions" (salient attributes) according to the overall "size" of the problem.

Looking down any column, it is clear that whatever determined the degree of difficulty of a decision problem, it was not the total number of bits of information presented alone. In fact the table suggests the most important factor is the number of salient dimensions. Holding the number of salient dimensions constant, performance does fall off as the total amount of information presented increases (except

TABLE 2: Two Items - Two Attributes

# Salient Attributes	Correct	Incorrect	
One Dimension	237	57	(includes 3 indifferent)
Proportion	.81	.19	
Two Dimensions	170	121	(includes 14 indifferent)
Proportion	.58	.42	

	Correct	Incorrect	Total
One Dimension	237	57	294
Two Dimensions	170	121	291
Total	407	178	585

(χ^2 = 34.0)

TABLE 3: Two Items - Three Attributes

# Salient Attributes	Correct	Incorrect	
One Dimension	235	59	(includes 5 indifferent)
Proportion	.80	.20	
Two Dimensions	167	58	(includes 5 indifferent)
Proportion	.74	.26	
Three Dimensions	123	86	(includes 6 indifferent)
Proportion	.58	.42	

	Correct	Incorrect	Total	Matching Populations Only: Correct	Incorrect	Total
One Dimension	235	59	294	180	46	226
Two Dimensions	167	58	225	167	58	225
Total	402	117	519	347	104	451
			(χ^2 = 2.38)			(χ^2 = 1.87)
One Dimension	235	59	294	163	46	209
Three Dimensions	123	86	209	123	86	209
Total	358	145	503	286	132	418
			(χ^2 = 26.5)			(χ^2 = 17.7)
Two Dimensions	167	58	225	106	34	140
Three Dimensions	123	86	209	78	63	141
Total	290	144	434	184	97	281
			(χ^2 = 11.5)			(χ^2 = 12.9)

TABLE 4: Three Items - Three Attributes

# Salient Attributes	Correct	Incorrect	
One Dimension	189	105	(includes 4 indifferent)
Proportion	.64	.36	
Two Dimensions	140	86	(includes 2 indifferent)
Proportion	.62	.38	
Three Dimensions	81	128	(includes 4 indifferent)
Proportion	.39	.61	

				Matching Populations Only		
	Correct	Incorrect	Total	Correct	Incorrect	Total
One Dimension	189	105	294	126	83	209
Three Dimensions	81	128	209	81	128	209
Total	270	233	503	207	211	418
		(χ^2 = 32.0)			(χ^2 = 19.4)	
Two Dimensions	140	86	226	92	49	141
Three Dimensions	81	128	209	51	90	141
Total	221	214	435	143	139	282
		(χ^2 = 23.4)			(χ^2 = 23.8)	

TABLE 5: Four Items - Four Attributes

# Salient Attributes	Correct	Incorrect	
One Dimension	171	123	(includes 2 indifferent)
Proportion	.58	.42	
Four Dimensions	58	151	(includes 13 indifferent)
Proportion	.28	.72	

				Matching Populations Only		
	Correct	Incorrect	Total	Correct	Incorrect	Total
One Dimension	171	123	294	124	85	209
Four Dimensions	58	151	209	58	151	209
Total	229	274	503	182	236	418
		(χ^2 = 45.6)			(χ^2 = 42.4)	

TABLE 6: Five Items - Five Prospects

# Salient Attributes	Correct	Incorrect	
One Dimension	170	124	(includes 11 indifferent)
Proportion	.58	42	

TABLE 7:

Percent of Correct Response by Problem Size and Dimension

	# of Items - # of Attributes				
	2-2	2-3	3-3	4-4	5-5
1 Dimension	.81	.80	.64	.58	.58
2 Dimensions	.58	.74	.62		
3 Dimensions		.58	.39		
4 Dimensions				.28	

in going from two items and two attributes to two items and three attributes when two dimensions are salient), but we do not have enough data points to conclude that the number of attributes is more important than the number of alternatives in generating this effect. Staelin and Payne (1975) did conclude that the data from the experiments of Jacoby et al. support this conclusion, we cannot yet claim to have confirming evidence.

The effects of increasing the number of salient dimensions are clear as is the conclusion that our subjects were generally quite capable of ignoring irrelevant information. In only two of the eleven problems involving compound lotteries did the percentage of correct choices fall below approximately 60 percent, including one problem with sixteen component lotteries and one with twenty-five component lotteries. Observed behavior approached randomness (but was statistically different from it) only when the number of salient dimensions and the number of alternatives simultaneously increased.

IV. SUMMARY AND CONCLUSIONS

Our experimental results bear on several issues in the consumer research literature. In problems involving simple lotteries we found our subjects were quite capable of finding undominated choices, but they often chose different but undominated items when offered the same problem again, or a similar problem with several dominated items added to the choice set. These results are interesting when viewed in the context of the stochastic choice literature and recent consumer

research literature (McAlister, 1983; Huber, Payne, and Puto, 1982; Huber and Puto, 1983).

In problems involving compound lotteries our subjects did not perform quite as well as they did in the problems involving simple lotteries. Admittedly, whether an error rate is high or low is a subjective matter, but given that our subjects had no prior training with these tasks we feel their performance was still quite good. Moreover, Table 7 illustrates quite dramatically that the amount of information available is not by itself an adequate measure of problem difficulty. The number of salient attributes seems much more important.

This last observation is of some policy importance. It allows us to conclude, for example, that our experiments do not support the position that one should restrict the amount of information on product labels for fear of overwhelming consumers and thereby producing poor brand choices. In fact one could argue that the burden of proof really should be on those who claim that information overload is a problem. Slovic, Fischoff, and Lichtenstein (1982) argue that judgments about risks are commonly based on misinformation and badly biased. They argue that there is need for providing extra information and educational programs to offset the systematic biases that would otherwise be present. However the subjects in our experiments acted as if they were able to ignore unnecessary bits of information. Thus, if for a consumer only a few attributes of a good are important, it doesn't follow that providing information on other attributes will be dysfunctional. Since the important attributes may vary across people this is an encouraging finding.

Our study also raises a number of other issues. In particular it demonstrates that "information overload," if it exists, is a poorly understood phenomenon. In fact, as it stands, the concept is not even well-defined. No perfectly general definition may be possible, however, since it is not obvious how one should measure "information load." All we know now is that "bits" certainly is not appropriate. There are also issues here involving internal versus external processing costs (Bettman, 1979). The former seem more important than the latter for our problems, but again, whether this is generalizable remains to be seen.

APPENDIX

FIGURE A1

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	$7.60 if 1-35 $3.70 if 36-100	-$.45 if 1-25 $.10 if 26-100	$4.50 if 1-60 $7.75 if 61-100
Item B	$.30 if 1-75 -$.25 if 76-100	$8.00 if 1-40 $5.00 if 41-100	$3.50 if 1-65 $7.40 if 66-100

Indicate your choice by circling the appropriate answer:

A B Don't Care

Prospect 1	Prospect 2	Prospect 3
Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3) __________

FIGURE A2

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	$15.00 if 1-33 $0 if 34-100	$20.00 if 1-65 $22.00 if 66-100	-$10.00 if 1-100
Item B	$4.80 if 1-100	$20.00 if 1-65 $22.00 if 66-100	-$15.00 if 1-67 $0 if 68-100

Indicate your choice by circling the appropriate answer:

A B Don't Care

Prospect 1	Prospect 2	Prospect 3
Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3) __________

FIGURE A3

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	$3.15 if 1-25 $6.00 if 26-100	$6.25 if 1-55 $2.75 if 56-100	$5.75 if 1-35 $2.25 if 36-100
Item B	$2.50 if 1-45 $5.50 if 46-100	$3.00 if 1-65 $6.50 if 66-100	$5.25 if 1-75 $2.40 if 76-100

Indicate your choice by circling the appropriate answer:

A B Don't Care

Prospect 1	Prospect 2	Prospect 3
Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3) __________

FIGURE A4

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	$8.00 if 1-60 $4.75 if 61-100	$.75 if 1-35 $.40 if 36-100	$.35 if 1-70 -$.10 if 71-100
Item B	$7.00 if 1-55 $4.50 if 56-100	-$.40 if 1-30 $.05 if 31-100	$1.05 if 1-35 $.70 if 36-100

Indicate your choice by circling the appropriate answer:

A B Don't Care

Prospect 1 ____ Prospect 2 ____ Prospect 3 ____

Outcome____ ____ Outcome____ ____ Outcome____ ____

Value__________ Value__________ Value__________

Total Value (Prospects 1 + 2 + 3) __________

FIGURE A5

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	$2.50 if 1-70 $5.85 if 71-100	$5.05 if 1-60 $.60 if 61-100	$6.00 if 1-35 $3.25 if 36-100
Item B	$5.60 if 1-30 $1.15 if 31-100	$3.20 if 1-65 $5.75 if 66-100	$1.95 if 1-70 $5.30 if 71-100
Item C	$3.05 if 1-65 $5.90 if 66-100	$.20 if 1-40 $4.65 if 41-100	$6.25 if 1-30 $2.90 if 31-100

Indicate your choice by circling the appropriate answer:

A B C Don't Care

Prospect 1 ____ Prospect 2 ____ Prospect 3 ____

Outcome____ ____ Outcome____ ____ Outcome____ ____

Value__________ Value__________ Value__________

Total Value (Prospects 1 + 2 + 3) __________

FIGURE A6

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	$.50 If 1-40 $.25 if 41-100	$14.00 if 1-25 $6.00 if 26-100	$1.00 if 1-45 $.60 if 46-100
Item B	$.15 if 1-60 $.40 if 61-100	$.70 if 1-55 $1.10 if 56-100	$5.75 if 1-75 $15.00 if 76-100
Item C	-$.05 if 1-60 $.20 if 61-100	$17.00 if 1-25 $8.00 if 26-100	$.90 if 1-55 $1.30 if 56-100

Indicate your choice by circling the appropriate answer:

A B C Don't Care

Prospect 1	Prospect 2	Prospect 3
Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3) __________

FIGURE A7

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	-$.70 if 1-60 -$.15 if 61-100	$9.15 if 1-25 $4.50 if 26-100	$7.75 if 1-30 $4.00 if 31-100
Item B	$7.00 if 1-70 $9.00 if 71-100	-$.05 if 1-40 -$.60 if 41-100	$4.40 if 1-75 $9.05 if 76-100
Item C	$7.75 if 1-25 $3.10 if 26-100	$8.00 if 1-30 $5.00 if 31-100	$1.25 if 1-40 $.70 if 41-100

Indicate your choice by circling the appropriate answer:

A B C Don't Care

Prospect 1	Prospect 2	Prospect 3
Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3) __________

FIGURE A8

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3	Prospect 4
Item A	\$.45 if 1-30 \$.60 if 31-100	\$.35 if 1-25 -\$.10 if 26-100	-\$.30 if 1-55 -\$.15 if 56-100	\$16.50 if 1-20 \$10.00 if 21-100
Item B	\$.45 if 1-25 \$.00 if 26-100	-\$.35 if 1-45 -\$.50 if 46-100	\$14.00 if 1-40 \$10.75 if 41-100	\$.70 if 1-70 \$.55 if 71-100
Item C	\$.80 if 1-30 \$.95 if 31-100	\$17.00 if 1-40 \$11.00 if 41-100	-\$.25 if 1-75 \$.20 if 76-100	-\$.50 if 1-55 -\$.35 if 56-100
Item D	\$10.00 if 1-60 \$15.00 if 61-100	-\$.25 if 1-45 -\$.40 if 46-100	\$.65 if 1-70 \$.50 if 71-100	-\$.05 if 1-75 \$.40 if 76-100

Indicate your choice by circling the appropriate answer:

A B C D Don't Care

Prospect 1	Prospect 2	Prospect 3	Prospect 4
Outcome____ ____	Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3 + 4) __________

FIGURE A9

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3	Prospect 4
Item A	\$5.65 if 1-40 \$.80 if 41-100	\$.75 if 1-60 \$5.85 if 61-100	\$4.40 if 1-45 \$3.65 if 46-100	\$4.15 if 1-30 \$6.05 if 31-100
Item B	\$5.25 if 1-70 \$3.35 if 71-100	\$.35 if 1-60 \$5.20 if 61-100	\$7.10 if 1-40 \$1.00 if 41-100	\$5.65 if 1-45 \$4.90 if 46-100
Item C	\$6.30 if 1-40 \$.75 if 41-100	\$5.45 if 1-70 \$3.55 if 71-100	\$2.65 if 1-60 \$7.50 if 61-100	\$2.40 if 1-55 \$3.15 if 56-100
Item D	\$5.20 if 1-45 \$4.45 if 46-100	\$6.50 if 1-35 \$1.00 if 36-100	\$2.85 if 1-30 \$4.75 if 31-100	\$6.15 if 1-40 \$1.30 if 41-100

Indicate your choice by circling the appropriate answer:

A B C D Don't Care

Prospect 1	Prospect 2	Prospect 3	Prospect 4
Outcome____ ____	Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3 + 4) __________

FIGURE A10

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3	Prospect 4	Prospect 5
Item A	\$.35 if 1-65 \$.20 if 66-100	\$18.40 if 1-20 \$10.00 if 21-100	\$.15 if 1-45 -\$.20 if 46-100	\$.60 if 1-25 \$.30 if 26-100	\$1.05 if 1-60 \$.45 if 61-100
Item B	\$.30 if 1-40 \$.90 if 41-100	\$20.25 if 1-30 \$11.00 if 31-100	\$.30 if 1-45 -\$.05 if 46-100	\$.35 if 1-35 \$.50 if 36-100	\$.15 if 1-75 \$.45 if 76-100
Item C	\$.40 if 1-45 \$.05 if 46-100	\$17.00 if 1-25 \$10.25 if 26-100	\$.85 if 1-35 \$1.00 if 36-100	\$.25 if 1-25 -\$.05 if 26-100	\$.50 if 1-60 -\$.10 if 61-100
Item D	\$1.10 if 1-25 \$.80 if 26-100	\$18.40 if 1-30 \$10.30 if 31-100	-\$.45 if 1-60 -\$1.05 if 61-100	\$.70 if 1-65 \$.55 if 66-100	\$.45 if 1-55 \$.80 if 56-100
Item E	-\$.15 if 1-75 \$.15 if 76-100	\$10.00 if 1-70 \$18.75 if 71-100	-\$.95 if 1-40 -\$.35 if 41-100	\$.75 if 1-55 \$1.10 if 56-100	\$1.25 if 1-65 \$1.10 if 66-100

Indicate your choice by circling the appropriate answer:

A B C D E Don't Care

Prospect 1	Prospect 2	Prospect 3	Prospect 4	Prospect 5
Outcome____ ____	Outcome____ ____	Outcome____ ____	Outcome____ ____	Outcome____ ____
Value__________	Value__________	Value__________	Value__________	Value__________

Total Value (Prospects 1 + 2 + 3 + 4 + 5) ___________

APPENDIX

INSTRUCTIONS

This is part of a study of decisionmaking under uncertainty. During this session you will make several decisions. At the end of the session you will be paid and the amount you earn will depend on the decisions you make. After you have made all your decisions, some of them will be selected (by chance) and you will be paid based upon the outcomes of those decisions.

If you look at the front of the room you will see a randomizing device otherwise known as a bingo cage. The bingo cage contains ten (10) balls numbered 0,1,...,9. During the session the bingo cage will be used to generate random numbers. The way we shall use the cage to generate numbers 1 to 100 is as follows:

(i) First we spin the cage until a ball comes out. This determines the right (units) digit.

(ii) Next, we replace the ball drawn and spin the cage until a ball comes out again. This determines the second (tens) digit.

For example, if the first ball drawn is a seven (7) and the second ball drawn is a three (3), then the number would be 37. Double zero will be counted as 100. If we wish to generate three digit numbers (1 to 1000), we will continue the same procedure with the third number drawn being the hundreds digit (triple zero being counted as 1000), etc.

All the decisions you will make during this session will involve what we call <u>prospects</u>. A prospect is a list of possible values together with a rule which says how the actual value of the prospect will be determined. The values of all prospects will be determined by generating a number using the bingo cage. For example, a prospect might be the following:

$10.00 if 1-25

$ 3.00 if 26-100.

The value of this prospect would be determined by generating a number (1 to 100) using the bingo cage as described above. If the number generated is 1,2,3,...,or 25, the value of the prospect will be $10; if the number generated is 26,27,...,100, the value of the prospect will be $3. Thus if the first number drawn is a two (2) and the second is a four (4), the number would be 42 and the value of the prospect would be $3. Prospects may have more than two possible values and some of the values may be negative. For example:

$27.00 if 1-200

$14.00 if 201-550

-$6.00 if 551-750

$3.75 if 751-1000

Note that in this case the value of the prospect would be determined by generating a three digit number using the bingo cage. If the number is 477, the prospect is worth $14. If the number is 703, the prospect is worth -$6. We will now generate a three digit number and ask each of you to determine the value of the prospect.

Number ____ ____ ____ Value of prospect ____________

All decisions you make will involve choosing between prospects

or between sets of prospects (which, to keep simple, we shall just refer to as "items"). Thus you will simply have to choose one of several items each consisting of one or more prospects. In each problem you will be asked to indicate your choice. If you are indifferent, you may note this and the choice will be made for you by the experimenter using the bingo cage.

We shall select one individual as a monitor to watch the procedure, to examine the equipment, and to make sure that the experimenters are really doing what they say they are doing. The monitor should check the truthfulness of what the experimenter says, but other than that, may not communicate any information to you in any way. If the monitor communicates any other information, he or she will be asked to leave without payment. The monitor will receive $______.

PART I

All the decisions in this part will be to choose a single prospect from a set of prospects. As each prospect will typically have more than two possible values, and there usually will be several prospects to choose from, we shall adopt a simplified way of displaying these prospects. In this problem the set of possible values is the same for all the prospects, so we have labeled each column with one of the dollar values. The following table illustrates these displays.

Choose one of the following items.

	\$20	\$10	\$5	-\$5
Item A	1-30	31-50	51-75	76-100
Item B	1-25	26-50	51-79	80-100
Item C	1-27	28-50	51-72	73-100
Item D	1-22	23-37	38-72	73-100

Indicate your choice by circling the appropriate answer.

A B C D don't care

Outcome ____ _____ Value of prospect chosen ________

If one of these problems is chosen for payment, then a number from 1 to 100 will be generated to determine the value of item A; then another number will be generated to determine the value of item B; and so on until the value of each item has been determined. Your payment would be the value of the item you selected.

PART II

The decisions in this part are similar to those in Part I. The only difference is that each of the items will consist of more than one prospect though the prospects will be simpler, each having only two possible values. Again, for simplicity we shall display the choices in a tabular form. Note that the possible values may differ.

<u>Example</u>

Choose one of the following items:

	Prospect 1	Prospect 2	Prospect 3
Item A	\$7 if 1-20 0 if 21-100	\$5 if 1-50 0 if 51-100	0 if 1-30 -\$6 if 31-100
Item B	\$3.50 if 1-100	\$2.50 if 1-100	\$20 if 1-25 -\$15 if 26-100
Item C	\$10 if 1-20 -\$3 if 21-100	\$10 if 1-50 -\$5 if 51-100	\$10 if 1-30 -\$16 if 31-100

Indicate your choice by circling the appropriate answer.

A B C don't care

Prospects 1 Prospects 2 Prospects 3

Outcome ____ ____ Outcome ____ ____ Outcome ____ ____

Value __________ Value __________ Value __________

Total Value (Prospects 1+2+3) __________

If one of these decisions is chosen for payment, then for each prospect in each item a number between 1 and 100 (or 1 and 1000) must

be generated. The payment you would receive would be the sum of the values of the prospects in the item of your choice.

FOOTNOTES

1. Bettman also notes, however, that Lussier and Olshavsky (1974) do not get this result. One possible explanation is that the crucial factor is whether a high rate of internal processing is required. Our results tend to support this view.

2. For example, consider the following typical consumer choice problem. Suppose for a given decisionmaker only one or two attributes carry much subjective weight. In a random sample of two drawn from a set of sixteen attributes, say, it is unlikely that either of these attributes will be present. The decisionmaker will then need to rely on unimportant attributes in making a choice, and it is likely both will be used. Similarly, if a decisionmaker only sees four of sixteen attributes, drawn randomly, it is still likely that all will be needed to make a choice. But once the "important" attributes are in the sample, a choice can be based on them and irrelevant information ignored. This will tend to produce an inverted u-shaped curve as far as information use is concerned, but performance will be monotonically increasing as a function of _available_ information.

3. The notion of dominance we employ in these experiments is quite simple. If lottery A can be obtained from lottery B by increasing some of the outcomes of lottery B (in all cases our outcomes are dollar values), then lottery A is said to dominate lottery B.

Similarly, for a fixed set of outcomes, shifting probability from lower valued outcomes to higher valued outcomes will construct a superior lottery.

4. These experiments also relate to issues in the so-called "framing" literature. See Grether and Wilde (1982) for details.

5. Not all of the decision problems were presented in tabular form. Two sets of problems were given with the lotteries simple written out. For each of these problems the results were essentially the same as for those using the tabular form of presentation, so we subsequently used only the tables for presenting the exercises to our subjects as they were easier to work with, especially for the complicated problems. It is significant however, that the results we obtain do not appear to be an artifact of the method of presentation although we have not systematically explored this dimension of our experimental design.

6. Dominance is again defined as in footnote 3, after the compound lotteries have been reduced to simple lotteries.

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